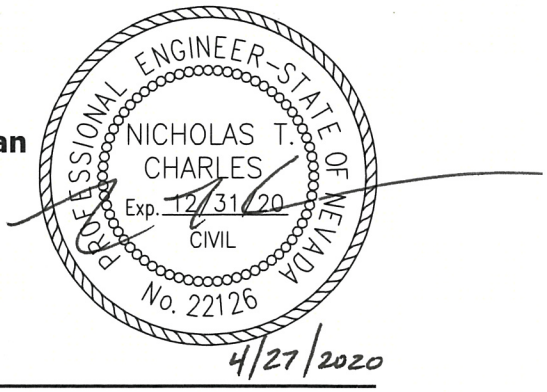
LUMOS & ASSOCIATES

Carson Water Subconservancy District Water Marketing Plan Update Memorandum



To Carson Water Subconservancy District
From Nicholas Charles, PE – Lumos & Associates
Date April 14, 2020

On June 19, 2019, the Carson Water Subconservancy District (CWSD) approved a contract with Lumos & Associates (Lumos) to assist CWSD with the compilation and completion of a Water Marketing Study. The project is being funded through a US Bureau of Reclamation WaterSmart Marketing Strategy Grant. The final report is scheduled to be completed by June 2021. The purpose of this memorandum is to provide an update to CWSD Board of Directors and staff on the current progress and the next steps to complete the Water Marketing Plan.

At this point in the project, Lumos has been focused on several work activities, including:

1. Combined stakeholder outreach in conjunction with CWSD staff.
2. Background data collection, analysis, and preparation of associated sections of the Water Marketing Plan report.

The following sections will provide an update on these work activities.

1. Stakeholder Outreach

Extensive outreach has occurred through the efforts of CWSD staff with the assistance of Lumos for select stakeholders. Lumos and CWSD staff have jointly met with the Nevada State Engineer, the Federal Water Master, Churchill County, Lyon County, Carson City, Douglas County, Vidler Water Company, and the Truckee-Carson Irrigation District. CWSD staff has also met with most, if not all, of the remaining major community water systems (Minden, Gardnerville Water Co, Stagecoach GID, Silver Springs GID, etc.) and their staff. The purpose of these meetings and other coordination has been to educate local stakeholders on the purpose of the Water Marketing Plan, elicit discussion and feedback, and request data that may be useful to the study. This stakeholder outreach has and will continue to provide valuable insight and data.

2. Background Data Collection and Analysis

Various datasets have been collected and analyzed to provide insight into current water availability and usage patterns in the Carson River watershed. In general, data related to instream flows, community water system water usage, hydrographic basin water usage, and water rights has been collected. The following summarizes the data and analysis as of the date of this memorandum.

Instream Flows

Annual average and peak day instream flow data was obtained from the USGS National Water Information System (USGS, 2020). The USGS has historically maintained multiple gauges along the Carson River; however, over time a number of those gauge locations have been taken out of service. Even with some of the gauges out of services there are four primary, longstanding

gauges that were utilized to obtain reliable river flow data. Table 1 provides summary gauge details, historical data, and statistical analysis of these four longstanding gauges located along the East Fork, West Fork, and main fork of the Carson River[1].

Table 1 – Summary of Historical Flow Data and Statistics

Location	West Fork at Woodfords	East Fork near Gardnerville	Carson River near Carson City	Carson River near Fort Churchill
USGS Station #	10310000	10309000	10311000	10312000
Latitude	38.769722	38.845194	39.107778	39.291667
Longitude	-119.832778	-119.706083	-119.712222	-119.311111
Data Record Analyzed	1940 to 2018	1940 to 2018	1940 to 2018	1940 to 2018
Annual Average Flow, CFS	103.0	365.4	401.1	377.4
Annual Flow Standard Deviation, CFS	50.2	181.3	256.4	258.4
Average Peak Day Flow, CFS	1,150.7	3,599.5	4,178.8	3,278.8
Peak Day Flow Standard Deviation, CFS	1,253.8	3,579.0	5,544.0	3,700.5
Annual Average to Peak Day Average Multiplier	11.2	9.9	10.4	8.7

Figure 1 through Figure 4 shows the annual average and peak day instream flows for each gauge listed in Table 1. For each gauge location, average annual flows can vary significantly from year to year. The "average" flow does not consistently occur, it is arguably just the average of extreme high and low flows that occur from year to year.

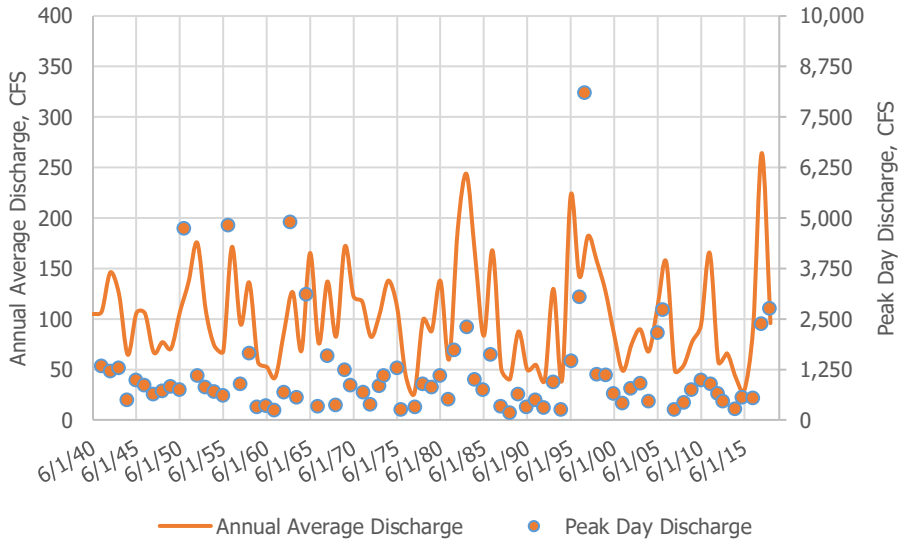


Figure 1 – West Fork at Woodfords Historical Data (USGS #10310000)

[1] Due to inconsistent data in the early 1900's, each dataset was reduced to the years 1940 to 2018.

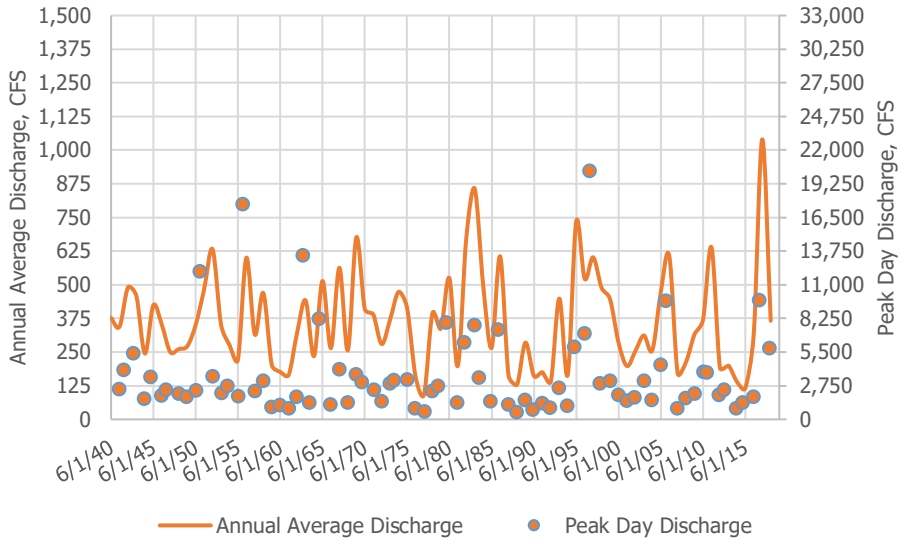


Figure 2 – East Fork near Gardnerville Historical Data (USGS #10309000)

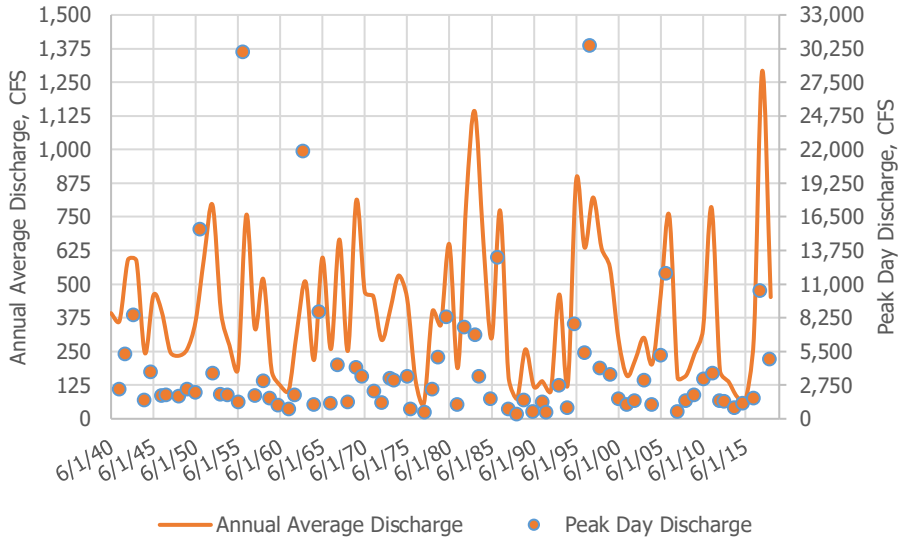


Figure 3 – Carson River near Carson City Historical Data (USGS #10311000)

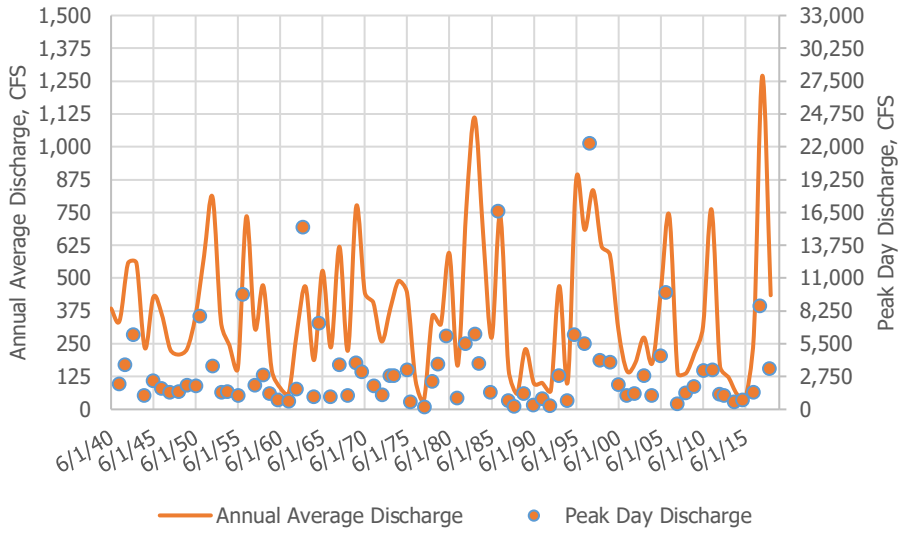


Figure 4 – Carson River near Fort Churchill Historical Data (USGS #10312000)[2]

Figure 5 through Figure 8 shows the 10-year running annual average flow and 10-year running average sample standard deviation for the gauges listed in Table 1 from 1940 to 2018. The 10-year running average is simply the average of the 10-years prior to each date shown in the Figures. The 10-year running average calculation helps average out extreme highs and lows and provides better insight into trends in the dataset. Each figure includes a trendline and associated regression equation through the 10-year running average calculation. The trend line for each gauge shows a trend of decreasing flows at each gauge location. Regression statistics indicate that the negative trend is statistically significant at the West Fork, East Fork, and Carson City gauges but is not as significant at the Fort Churchill gauge. Using the regression equation for each trendline[3], Table 2 provides estimates of the annual average decrease in flow and the cumulative decrease in flow from 1940 to 2018. It should be noted that these decreases in flow are long-term trends and do not indicate conditions from year to year. The Fort Churchill gauge showed the lowest decrease in flow as a percentage of average flow and the Carson City gauge showed the highest decrease in flow as a percentage of average flow. For comparison, Table 2 also includes combined flows from the East and West Fork gauges. These two gauges largely indicate the natural flow in the Carson Watershed and provide a baseline for other flows.

Interestingly, a time period analysis comparing average instream flows between 1940 to 1979 with average instream flows between 1980 to 2019 shows flows were actually higher in the period between 1980 and 2019. It is assumed that his discrepancy between the regression and time period analysis may be attributable to the increased variation in instream flows (as indicated by the standard deviation which is discussed below). Theoretically, instream flows

[2] Figure 4 represents data taken from the USGS gauge and does not account for potential return flows from the Buckland Ditch that are diverted upstream of the USGS gauge and at times return to the River downstream of the gauge. This data and its impact will be reviewed prior to the final report.
[3] The slope of the regression equation indicates the average change in flow per year in CFS.

cannot drop below 0 CFS but theoretically there is no upper limit to flows. Not having a theoretical upper flow limit may be skewing the outputs of the time period analysis. For example, at the Carson City Gauge (see Figure 3) there was only one year between 1940 and 1979 where the average annual flow exceeded 802 CFS (double the average) but there are five years between 1980 and 2018 that exceeded 802 CFS. Similarly, at the Carson City gauge there were only six years between 1940 and 1979 where the average flow never exceeded 201 CFS (half the average). Between 1980 and 2018, there were 14 years where average flow never exceeded 201 CFS.

Figure 5 through Figure 8 also shows the 10-year running sample standard deviation for the Carson City gauge dataset. Standard deviation is a measure of how much variance is in a dataset or in other words how far the data varies from the average. The trendline through the 10-year running sample standard deviation has a significant positive slope, indicating that the sample standard deviation has been increasing over time. The interpretation of this trend is that instream flows have become more variable over time (as discussed in the previous paragraph).

The conclusion of this analysis is that instream river flows are becoming more inconsistent with higher highs, more frequent lows (can never go below 0 CFS), and a decreasing trend in instream flows. This trend is true for each gauge listed in Table 1. For water users along the Carson River, these trends are troubling. The result is an amplification of the "feast or famine" condition that already exists for the Carson River with the average flow slowly decreasing. If this trend continues, flows will continue to become more extreme, less reliable, and continue to decline. The lack of significant storage in the upper watershed prevents any stabilization or mitigation of these extremes.

Table 2 – Trends in Instream Flow

Location		West Fork at Woodfords	East Fork near Gardnerville	West Fork + East Fork	Carson River near Carson City	Carson River near Fort Churchill
Annual Change in Flow	CFS	-0.1	-0.2	-0.3	-0.5	-0.2
	AFA	-75.7	-136.5	-212.2	-334.7	-131.0
	MG/yr	-24.7	-44.5	-69.1	-109.1	-42.7
Change in Flow between 1940 and 2018	CFS	-8.2	-14.7	-22.9	-36.1	-14.1
	AFA	-5,901	-10,650	-16,551	-26,105	-10,215
	MG/yr	-1,923	-3,470	-5,393	-8,506	-3,329
Average Flow between 1940 and 2018	CFS	103.0	365.4	468.3	401.1	377.4
	AFA	74,617	264,698	339,249	290,594	273,438
	MG/yr	24,134	86,252	110,544	94,690	89,100
% Average Annual Change in Flow		-0.10%	-0.05%	-0.06%	-0.12%	-0.05%
% Average Change in Flow between 1940 and 2018		-7.91%	-4.03%	-4.88%	-8.99%	-3.74%

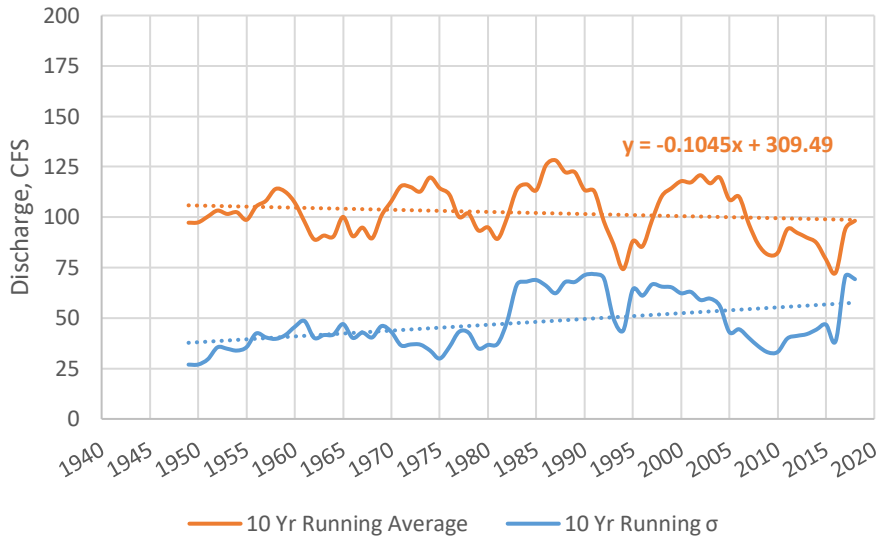


Figure 5 – West Fork at Woodfords 10-Year Running Average (USGS #10310000)

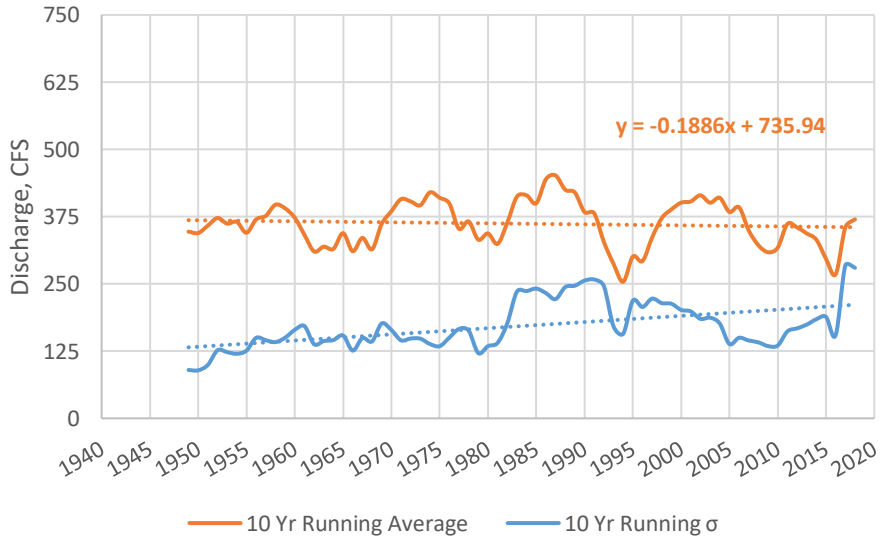


Figure 6 – East Fork near Gardnerville 10-Year Running Average (USGS #10309000)

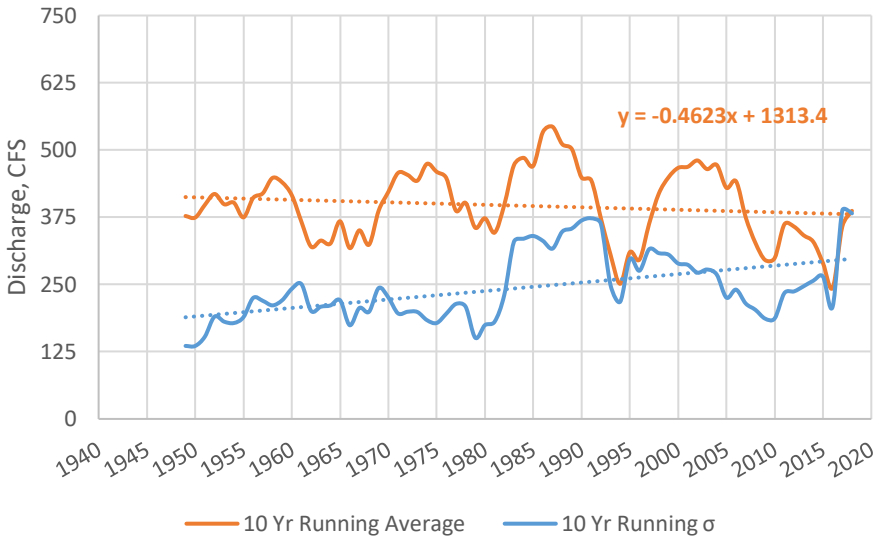


Figure 7 – Carson River near Carson City 10-Year Running Average (USGS #10311000)

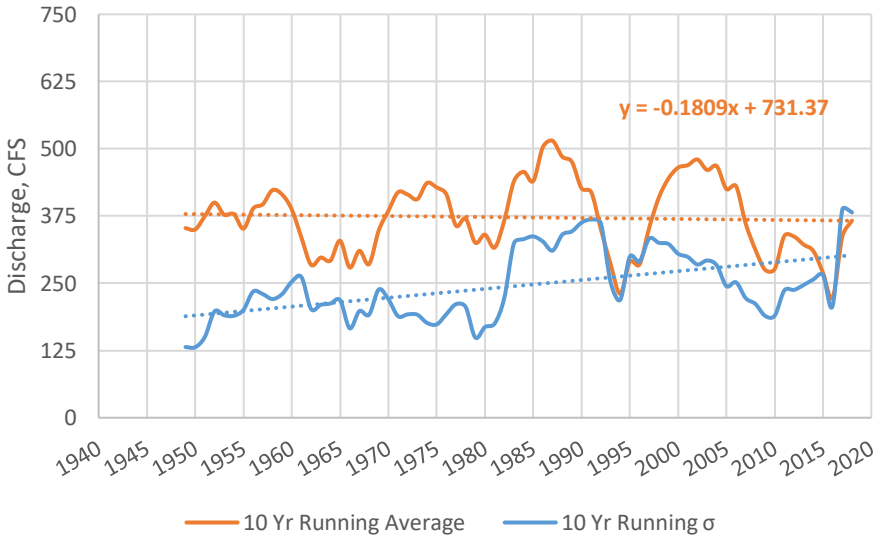


Figure 8 – Carson River near Fort Churchill 10-Year Running Average (USGS #10312000)[2]

Community Water System Usage

Within the Carson River Watershed there are 84 regulated potable water systems stretching from Alpine County to Churchill County. Of these systems, there are 32 "community" water systems[4] that provide water to approximately 44,019 residential, commercial, industrial, and landscape

[4] A community water system is defined as a system that supplies water to the same population year-round.

irrigation water services connections in the watershed. The remaining 52 regulated systems are classified as non-community water systems which include businesses not connected to a municipal water system, parks, campgrounds, etc. Non-community water systems were not analyzed as part of this project (California State Water Resources Board, n.d.; Nevada Division of Environmental Protection, n.d.).

Of the 32 community water systems in the watershed, data usage was collected from 18 systems, representing 97.5% of the water system service connections[5]. Table 3 contains summary data from these water systems. Data presented in this table is taken primarily from pumpage records from 2015 to 2019 and is ordered from highest usage per connection to the smallest usage per connection. The average total annual usage for these water utilities is 25,796 AFA. Assuming that all other community water systems usage is consistent with those systems shown in Table 3, total community water system demand in the Carson watershed (for all 32 community water systems) would be approximately 26,463 AFA, or 8,623 million gallons of water per year.

All of these water systems use groundwater to meet system demand. However, Carson City, Douglas County, and Lyon County Utilities also utilize surface water for potable use. Carson City utilizes induction wells and diverts water from Kings Creek, Ash Creek, and the Marlette Hobart Water System (MHWS) for treatment at the Quill water treatment plant. The MHWS transfers water from the Tahoe Basin / Truckee River watershed to Carson City. On average, 17%, of Carson City's public water supply comes from Kings Creek, Ash Creek, and the MHWS and 11%, comes from induction wells. Douglas County utilizes one induction well off of Jack's Valley Road which accounts for approximately 2.0% of their water usage. Lyon County utilizes an induction well in the vicinity of the Rolling A wastewater treatment plant. In 2019, this induction well accounted for approximately 24.7% of water usage in the Lyon County Utility District water system[6].

Table 3 – Summary of Community Water System Usage

	Connections	% of Connections	Average Annual Usage (AFA)[E]	% of Average Usage	AFA per Connection[F]	% of Avg AFA per Connection
Douglas County[A]	2,378	6.4%	2,088	8.1%	0.76	126.9%
Gardnerville Ranchos GID[A]	3,992	9.3%	2,881	11.2%	0.72	120.0%
Town of Minden[B]	1,799	4.2%	1,252	4.9%	0.70	115.8%
City of Fallon[B]	3,215	7.5%	2,220	8.6%	0.69	114.9%
Carson City[A]	16,883	39.3%	11,078	42.9%	0.66	109.1%
Churchill County[C]	271	0.6%	147	0.6%	0.54	90.5%
Gardnerville Water Co [A]	2,376	5.5%	1,279	5.0%	0.54	89.5%

[5] Douglas County operates 6 different permitted community water systems in the Carson Valley. For simplicity these systems collectively referred to as Douglas County.
[6] Lyon County's induction well (Well 20) usage varies from year to year. In the past, pumpage from this well has been impacted by system hydraulics, construction projects, and instream flows.

	Connections	% of Connections	Average Annual Usage (AFA)[E]	% of Average Usage	AFA per Connection[F]	% of Avg AFA per Connection
Indian Hills GID[A]	1,950	4.5%	995	3.9%	0.51	84.8%
Stagecoach GID[B]	564	1.3%	256	1.0%	0.45	75.5%
Silver Springs GID[B]	1,088	2.5%	484	1.9%	0.44	74.0%
Lyon County Utility District[A]	6,849	16.0%	2,772	10.7%	0.40	67.3%
Storey County[D]	635	1.5%	231	0.9%	0.36	60.6%
NAS Fallon[B]	550	1.3%	113	0.4%	0.21	34.2%
Total or Weighted Average	42,910		25,796		0.60	

[A] Data was provided directly from the utility to Lumos & Associates. Douglas County operates 6 community water systems in the Carson Valley.
[B] Data was provided to Lumos & Associates by CWSD staff
[C] Data extracted from *Churchill County Water and Wastewater Utilities Master Plan* (Shaw Engineering, 2019).
[D] Data provided to Lumos & Associates by the Marlette-Hobart Water System
[E] One-acre foot of water is equal to 325,851 gallons of water. The largest water user, Carson City, uses on average 3,609.6 million gallons of water per year, or 9.9 million gallons per day. The smallest user, NAS Fallon, uses 36.8 million gallons of water per year, or 0.2 million gallons per day.
[F] 1.12 AFA per equivalent dwelling unit (EDU) is commonly used for estimates of water use. 1.12 AFA is equal to nearly 1,000 gallons per day. In most cases, a water system will have more EDU's than water connections. The largest user on a per connection basis, Douglas County, uses on average 680 gallons per day per connection. The smallest user on a per connection basis, NAS Fallon, uses on average 183 gallons per day per connection. The weighted average usage is 544 gallons per day per connection.

Hydrographic Basin Usage

The Carson watershed is divided into seven distinct hydrographic basins, one in California and the remaining basins in Nevada (see Table 4). Groundwater withdrawal data from the hydrographic basins was obtained from the Nevada Division of Water Resources (State of Nevada Division of Water Resources, 2020). California Basin 6-006 and Nevada Basin 105 are physically the same hydrographic basin that is divided by the California-Nevada state line. On the California side of the Carson Valley Basin the primary users are a limited number of domestic wells. Since there are a limited number of users in the California portion of the Carson Valley Basin, it is assumed that data from the Nevada side of the basin is generally representative of the entire basin. Of the other basins, no groundwater withdrawal data is available from Nevada Basin 101A (Packard Valley). Data has been categorized as irrigation (agricultural), domestic (private wells), municipal / quasi-municipal, and other. The "other" category includes various mining, industrial, recreation, environmental, etc. uses.

Table 4 shows the average annual withdrawals by hydrographic basin from 2013 to 2017, the perennial yield (and system yield when available), and the percent of the perennial yield that is being withdrawn from each basin. Reported perennial and system yields are taken from the Nevada Department of Water Resources Hydrographic Basin Summaries (2020). Perennial yield refers to naturally occurring recharge through precipitation. System yield includes the perennial yield plus other sources of groundwater recharge such as irrigation and engineered recharge.

Active recharge sites include Carson City's aquifer storage and recovery (ASR) system in Vicee Canyon (primarily from the Marlette-Hobart Water System), recharge from bypassing Kings and Ash Creek around the Quill WTP, and wastewater rapid infiltration basins located at several locations in the watershed. System yield is generally considered a more accurate representation of aquifer capacity. It should be noted that estimation of the perennial and system yields are not exact and there are other entities that have indicated different basins yields. However, for this project, the Nevada Division of Water Resources is considered the authoritative source. From Table 4, Churchill Valley and the Carson Desert hydrographic basins are withdrawing more water than the perennial yield. However, over the entire watershed, between 64.3% and 75.9% of available aquifer capacity is currently being used. There is between 16,000 to 28,000 AFA of additional groundwater available in the Carson Watershed. If system yield is considered, the available aquifer capacity would be even greater.

In summary, based on available data, there is additional groundwater capacity in the Carson River watershed. The limitation in the Carson River Watershed is not the quantity of groundwater. The limitations are groundwater quality, hydrogeologic limitations of the aquifer, and transmission of available water. For example, the Carson Valley has aquifer capacity well in excess of the current demand. But, arsenic, low pH, manganese, fluoride, total dissolved solids (TDS), and nitrate are all documented water quality issues present in the Carson Valley that reduce the usability of groundwater for potable purposes. Treatment is required to correct these water quality issues before groundwater can be used for potable use. Other issues include sub-hydrographic basins with inadequate capacity to meet demand, such as the Ruhenstroth area of the Carson Valley or documented contamination of groundwater from septic systems (Naranjo, Welborn, & Rosen, 2013). Although Ruhenstroth, Fish Springs, and Johnson Lane are all located in the Carson Valley, these areas do not experience the same aquifer capacity that other areas of the Carson Valley do. Much of this has to do with recharge capacity (these areas on are on the east, or Pinenut side of the Carson Valley) and hydrogeologic conditions.

Table 4 – Carson Watershed Groundwater Basins

Groundwater Basin #	Groundwater Basin Name	2013 to 2017 Average Annual Withdrawals (AFA)	Perennial Yield (System Yield) (AFA)	Average Withdrawals as a % of Perennial Yield (System Yield)
CA 6-006	Carson Valley	31,460	49,000	64.2%
NV105	Carson Valley			
NV 104	Eagle Valley (Carson City)	4,607	4,900 (9,000)	94.0% (51.2%)
NV 103	Dayton Valley (Dayton)	8,723	8,000 to 20,000	109.0% to 43.6%
NV 102	Churchill Valley (Silver Springs)	2,267	1,600	141.7%
NV 101	Carson Desert (Fallon)	3,060	2,500	122.4%
NV 101A	Packard Valley	Unknown	710	Unknown
Total		50,116	66,000 to 78,000	75.9% to 64.3%

Figure 9 summarizes the average groundwater withdrawals as a function of withdrawal type and hydrographic basin. This figure shows the magnitude of the water used in the Carson Valley compared to other downstream basins. Between 2013 and 2017, groundwater withdrawals from the Carson Valley Basin accounted for 62.8% of all groundwater withdrawals in the Carson River Watershed. Eagle Valley, Dayton Valley, Churchill Valley and the Carson Desert accounted for 9.2%, 17.4%, 4.5%, and 6.1% of total groundwater withdrawals in the Carson River Watershed, respectively. It should be noted that data for withdrawals from domestic wells is estimated by the Nevada Division of Water Resources assuming each 1 AFA is withdrawn from each domestic well. Domestic well owners are not required to monitor use, so the reported values for domestic wells should only be considered an estimate.

Figure 10 illustrates the issued water rights as a percentage of the perennial yield. This Figure indicates that every hydrographic basin is over allocated based on currently issued water rights and estimated perennial yield. This is a potentially serious issue, however, it is not likely that all of the issued water rights will be exercised such that actual pumping will increase to the issued water rights volume (see Table 4). This water deficit could be partially mitigated by determining the system yield for each basin rather than using just the perennial yield. As previously discussed, system yield considers other recharges such as irrigation and engineered recharge systems.

Figure 10 highlights the discrepancy between "paper water" and "wet water". "Paper water" refers to a water right that allows an entity to withdraw water from the aquifer. Whereas "wet water" refers to the physical water in the aquifer. In many situations "paper water" exists where "wet water" does not exist or where it is not of sufficient quality for the intended use. In some areas, such as Silver Springs, there is an excess of "paper water" but insufficient "wet water" making some water rights essentially unusable. At times the volume of "wet water" can vary. For example, a 2011 USGS report documented long-term declines in static groundwater of more than 40-feet on the northwest side of Carson City and water level declines of 10-feet have been documented in the Carson Plains and Stagecoach sub-hydrographic basins (Maurer, 2011). However, more recent data suggests that some of this long-term static groundwater level decline has recovered, partially as a result of recharge activities in Carson City.

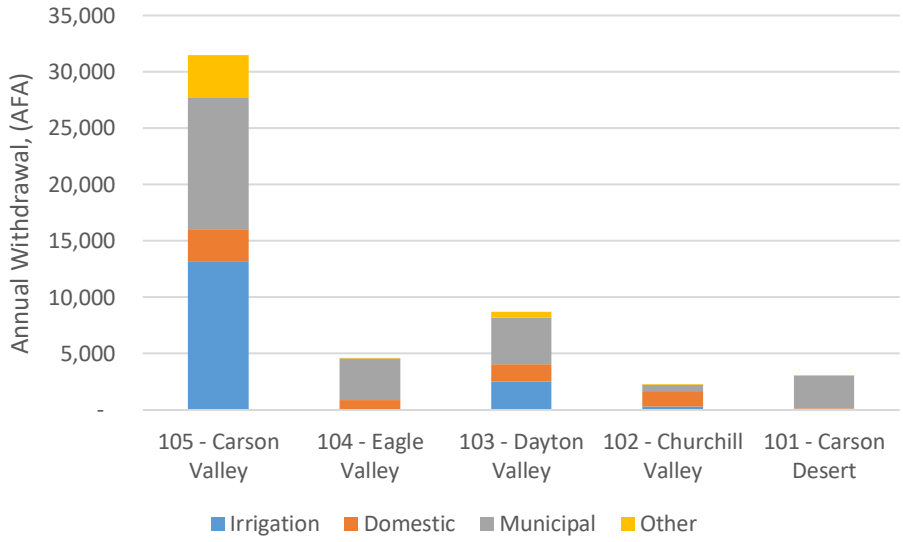


Figure 9 – Groundwater Withdrawals based on Category and Hydrographic Basin

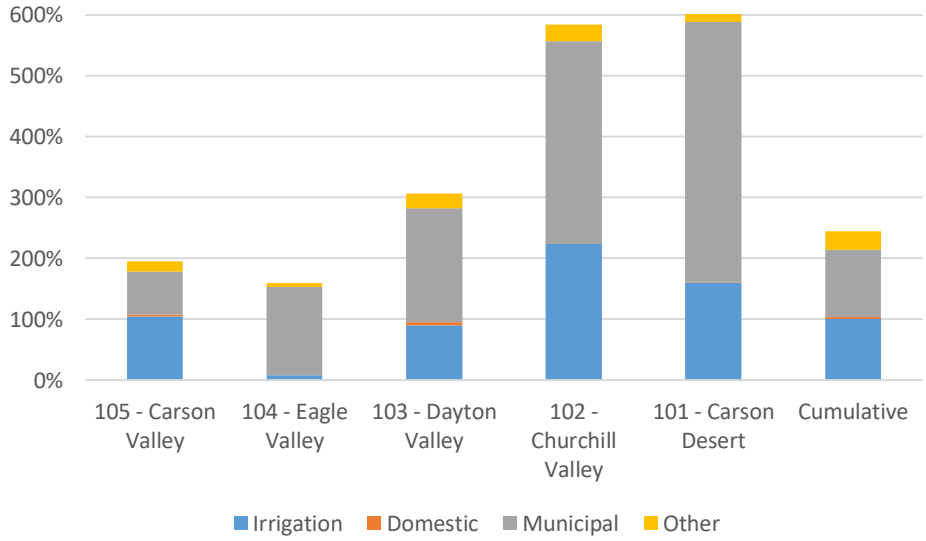


Figure 10 – Issued Water Rights as a Percentage of Perennial Yield

Water Rights

An extensive summary of surface water rights in the Carson watershed has been compiled. Over 2,000 surface water rights have been identified with associated data, including owner, priority, duty diversion location and source. This dataset will be used to better understand where excess surface water may be available and to develop concepts on how to more efficiently use it.

3. Current Institutional and Water Marketing Practices

In the Carson River Watershed, there are several existing programs, statutes, and decrees that govern the use of water, or the marketing of water. Regarding water marketing, the Alpine Decree and existing State water laws are of particular interest. The Alpine decree establishes

surface water duties on the Carson River in both California and Nevada, establishes the right to reservoir storage, and defines the operation of the river on rotation. In addition, the decree recognizes riparian rights in California and appropriative rights in Nevada (Nevada Division of Water Planning, 1999).

The Alpine Decree established eight (8) autonomous river segments (see Table 5). It also establishes consumptive use and duties for bottom, alluvial, and bench lands (see Table 6). The following summarizes the water distribution per river segment according to the Alpine Decree and Federal Water Master (Wathen, Larrouy, & Callahan, 2012):

1. Segment 1 – This segment consists of mostly riparian water rights and minimal regulation.
2. Segment 2 – This segment of river is regulated when flow at the Gardnerville gauge drops to 200 cfs. One-third of flows are diverted to the Allerman Canal and 2/3rds of flows remain in the river channel. Water is distributed based on priority.
3. Segment 3 – This segment consists of mostly riparian water rights and minimal regulation.
4. Segment 4 – Regulation of this segment is based on the *Anderson-Bassman Decree* and the *Price Decree*.
    a. The Anderson-Bassman Decree determines that the first Monday in June or when flows reach 100 cfs, water in the West Fork will be rotated between Segment 4 and Segment 5.
    b. The Price Decree controls rotation in segment 4.
5. Segment 5 – Water deliveries are based on priority. During weeks when California users receive water, any water that reaches Nevada is delivered to junior water rights.
6. Segment 6 – Diversions are by pumping. Water that reaches pumps meets the priority of the water right.
7. Segment 7 – This segment is regulated based on sub-segments a through e.
8. Segment 8 – This segment is not regulated by the Federal Water Master

In addition to the Alpine Decree, state water laws also govern how water is used. In Nevada, water law is based on the concept of prior appropriation and beneficial use. In other words, water rights grant priority to water users ("first in time, first in right") for designated beneficial uses (State of Nevada Division of Water Resources, 2020). Regarding surface water, California water law is a system of riparian rights and prior appropriation. However, groundwater laws in California are limited and relatively new. The 2014 Sustainable Groundwater Management Act (SGMA) requires Groundwater Sustainability Plans and groundwater restrictions on high and medium priority basins. The Carson Valley hydrographic basin is not classified as a priority basin (California Department of Water Resources, 2020).

Table 5 – Alpine Decree River Segments (Wathen, Larrouy, & Callahan, 2012)

Segment	River	Upper Boundary	Lower Boundary
1	East Fork	Headwater	CA/NV Stateline
2	East Fork	CA/NV Stateline	Confluence of East & West Forks
3	West Fork	Headwaters	USGS gauge at Woodfords
4	West Fork	USGS gauge at Woodfords	CA/NV Stateline
5	West Fork	CA/NV Stateline	Confluence of East & West Forks
6	Main	Confluence of East & West Forks	USGS gauge at Carson City
7	Main	USGS gauge at Carson City	Lahontan Reservoir
7(a)	Mexican Ditch and reach between Rose Ditch and Cardelli Ditch		
7(b)	Gee Ditch		
7(c)	Koch Ditch		
7(d)	Houghman and Howard Ditches		
7(e)	Buckland Ditch		
8	Main	Lahontan Reservoir	No lower boundary

Table 6 – Alpine Decree Duty and Consumptive Use (Nevada Division of Water Planning, 1999; Wathen, Larrouy, & Callahan, 2012)

	Newlands Project		Above Newlands Project	
	Duty	Consumptive Use	Duty[7]	Consumptive Use
Bottom Lands	3.5 AF/AC	2.99 AF/AC	4.5 AF/AC	2.5 AF/AC
Alluvial Fan Lands	NA	NA	6.0 AF/AC	2.5 AF/AC
Bench Lands	4.5 AF/AC	2.99 AF/AC	9.0 AF/AC	2.5 AF/AC

The Alpine Decree and prior appropriation determine rotation of surface water from the Carson River. However, the Alpine Decree does allow for the rotation and exchanging of water among ditches and users to improve water economy as long as the exchanges do not cause injury to other users. Through rotation, junior water rights are served as long as possible. In addition, the Alpine Decree allows for changes in the point of diversion, place of use, and manner of use. It should be noted that the process to change a point of diversion, place of use, and/or manner of use is an extensive and time consuming process.

Similar to the Alpine Decree, Nevada state water law allows for changes in the point of diversion, place of use, and manner of use for groundwater. Although there are numerous restrictions and limitations, groundwater rights in the Carson River watershed can be bought, sold, exchanged, and moved. However, these changes can require an extensive and time consuming process. These opportunities provide flexibility in how water can be used. Arguably, existing laws and the Alpine Decree allow for several methods of water marketing within the watershed to increase the efficiency of water used.

[7] In a 1980 Court Opinion regarding the upper watershed, the Court indicated that inadequate evidence existed to classify the three land types referenced in the Alpine Decree. The opinion then states that "the Water Master will exercise discretion in distributing water to meet the various demands of the various land types hereinabove noted, insofar as it is practical to do so" (The United States of America Vs. Alpine Land & Reservoir Company, a corporation, et al., 1980, pp. 27-28).

Within the context of the Alpine Decree and state water laws, entities within the Carson River have effectively used existing water marketing mechanisms to maximize the use of water in the watershed. The following is a summary of some of these efforts:

- Farm Unit – NRS 533.040 §4 states that a surface water right in a federal reclamation project is appurtenant to the "entire farm" and that the place of use can be the "entire farm" rather than an "identifiable" place within the farm. Water usage on the farm cannot exceed what has been allotted through decrees. This statute allows agricultural surface water users in the Newlands Project flexibility to use water where it may be most beneficial rather than a specific location within the farm unit. This concept is utilized primarily within the Truckee-Carson Irrigation District (TCID).
- Regionalization – Significant action has been taken in recent years to interconnect community water systems to maximize water availability and to utilize the most efficient sources of water. These activities include construction of regional water infrastructure as well as collaborative studies. Regional infrastructure project includes:
    - Douglas County regional water system – Through this system, water from the Town of Minden is distributed to Douglas County (specifically the East Valley and North County water systems), Indian Hills GID, and Carson City. This system is supported by miles of transmission mains, numerous water tanks, two booster stations, and interagency coordination.
    - Other system interties include:
        - Gardnerville Water Company – Town of Minden
        - Douglas County – Sierra Estates GID
        - Douglas County – Carson City
        - Carson City – Lyon County Utilities
        - Various interties between Douglas County's different community water systems (ie. the Foothill water system is connected to the Sheridan Acres system).
- Water Rights Dedications – Community water systems require either a dedication or purchase of existing water rights for new water system connections or developments. Historically, 1.12 AFA of water per residential connection has been required to either be dedicated to the water utility or purchased from the water utility[8]. This dedication rate exceeds average water usage (see Table 3) providing each entity a theoretical buffer between their "paper water" and "wet water." In addition, several water purveyors have indicated that they have acquired various surface water rights over time.
- Water Reuse – Numerous entities use reclaimed water in the Carson River Watershed. There are numerous wastewater treatment plants (WWTP) that eventually dispose of treated effluent to the Carson River Watershed. WWTPs range from outdated facilities to modern membrane systems that are able to meet stringent effluent requirements. The following is a summary of different treated wastewater that is discharged to the Carson River Watershed.
    - South Lake Tahoe PUD – STPUD pumps treated wastewater over Luther Pass (CA Highway 89) to Harvey Place reservoir in Diamond Valley. Water is used for

[8] In recent years some utilities have decreased this water right requirement per residential dwelling unit.

irrigation of agricultural crops in Diamond Valley. This system imports water from the Tahoe Basin / Truckee River Watershed to the Carson River Watershed.

- Douglas County Lake Tahoe Sewer Authority – DCLTSA pumps treated wastewater over Kingsbury Grade (NV Highway 207) to a storage reservoir in Carson Valley. Water is used for irrigation of agricultural crops in Carson Valley. This system imports water from the Tahoe Basin / Truckee River Watershed to the Carson River Watershed.
- Incline Village GID – IVGID pumps treated wastewater over Spooner Summit (US Highway 50) to the Carson Valley. Treated effluent is used for golf course irrigation, irrigation of agricultural crops, and wetlands disposal. This system imports water from the Tahoe Basin / Truckee River Watershed to the Carson River Watershed.
- Minden Gardnerville Sewer District – MGSD stores treated effluent in the Carson Valley for irrigation of agricultural crops. MGSD can store effluent in a storage reservoir adjacent to the WWTP or in a privately-owned reservoir.
- Indian Hills GID – IHGID disposes treated wastewater effluent through golf course irrigation. Storage is primarily in golf course water features.
- Douglas County – Douglas County disposes of treated wastewater effluent through irrigation of agricultural crops. Douglas County is also permitted to use a rapid infiltration basin (RIB) for disposal. During winter months Douglas County stores treated effluent in a lined storage reservoir adjacent to the North Valley WWTP.
- Carson City – Treated wastewater from the Carson City WWTP is used for golf course irrigation and irrigation of agricultural crops at the Prison farm. During winter months Carson City stores effluent in Brunswick Canyon Reservoir.
- Lyon County – Lyon County operates two wastewater treatment plants (Rolling A and South Plant). Treated effluent is used for golf course irrigation. However, a significant amount of effluent is disposed of through RIBs.
- Silver Springs – The Silver Springs WWTP is operated by Lyon County and primarily discharges treated effluent to the Silver Springs Airport for infiltration and evaporation.
- Churchill County – Treated effluent from the Moody Lane WWTP is primarily disposed of through evaporation / infiltration basins. However, the facility is permitted to discharge to the Wade Drain.
- City of Fallon – The City of Fallon is permitted to discharge treated effluent to the New River Drain.
- NAS Fallon – The Naval Air Station is permitted to discharge treated effluent to the Lower Diagonal Drain.

In many ways, water users within the Carson River Watershed are utilizing existing water marketing tools to maximize the benefits of the Carson River within the framework of the Alpine Decree and existing water laws. Numerous collaborative programs and projects are in place that have improved the use of Carson River water. Future projects and interagency efforts should attempt to maximize the availability of water for the benefit of the watershed.

4. Next Steps

Lumos & Associates is nearly finished with compiling data and analyzing background data for this project. Moving forward, Lumos is going to start developing concepts and alternatives looking at water marketing opportunities to more efficiently utilizing water resources in the watershed within the context of the Alpine Decree and other relevant water laws. These options will largely focus on municipal uses but may provide some additional benefits to other users. Water marketing concepts will evaluate how to extract water from the Carson River, store it, and then deliver it to users at a later time. For example, a possible concept would be to extract water from the Carson River during runoff (under a water right) and store the water in the aquifer (either through infiltration basins or injection wells) for extraction at a later time.

Lumos & Associates staff will continue to work closely with CWSD staff to ensure the project continues to progress in a satisfactory manner and meets the needs of the CWSD Board of Directors and BOR grant requirements.

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LUMOS & ASSOCIATES

Appendix A – List of Regulated Water Systems

	WS#	Water System Name	Type	County	Source
1	CA0202504	MARKLEEVILLE WATER CO.	C	ALPINE	SW
2	CA0202522	SIERRA PINES MOBILE HOME PARK	C	ALPINE	GW
3	CA0202503	WOODFORDS MUTUAL WATER COMPANY	C	ALPINE	GW
4	CA0202550	ALPINE CO. HEALTH & HUMAN SERVICES	NC	ALPINE	GW
5	CA0210300	CA STATE PARKS - GROVER HOT SPRINGS	NC	ALPINE	SW
6	CA0202515	CARSON RIVER RESORT	NC	ALPINE	GW
7	CA0202507	CHARITY VALLEY RANCH	NC	ALPINE	GW
8	CA0202532	CRYSTAL SPRINGS CG	NC	ALPINE	GW
9	CA0202529	HOPE VALLEY CG	NC	ALPINE	GW
10	CA0202520	HOPE VALLEY RESORT	NC	ALPINE	GW
11	CA0202543	INDIAN CREEK RES. CG (BLM)	NC	ALPINE	GW
12	CA0202513	SHAY CREEK SUMMER HOME TRACT	NC	ALPINE	GW
13	CA0202530	SILVER CREEK CG	NC	ALPINE	GW
14	CA0202516	SORENSON S HOA	NC	ALPINE	GW
15	CA0202512	SORENSON S RESORT	NC	ALPINE	GW
16	CA0202519	TURTLE ROCK COUNTY PARK	NC	ALPINE	GW
17	CA0202502	WOODFORDS STATION	NC	ALPINE	GW
18	CA0202501	DIAMOND VALLEY SCHOOL	NTNC	ALPINE	GW
19	CA0202599	EARLY LEARNING CENTER	NTNC	ALPINE	GW
20	NV0000015	CARSON CITY PUBLIC WORKS	C	CARSON CITY	SW
21	NV0000017	COTTONWOOD MHP	C	CARSON CITY	GW
22	NV0000028	TERRACE GARDEN APARTMENTS	C	CARSON CITY	GW
23	NV0002006	MILL HOUSE INN MOTEL	NC	CARSON CITY	GW
24	NV0004084	STEWART COMPLEX	NTNC	CARSON CITY	GW
25	NV0003068	CARSON RIVER ESTATES	C	CHURCHILL	GW
26	NV0000045	FALLON CITY OF	C	CHURCHILL	GW
27	NV0000350	FALLON NAVAL AIR STATION	C	CHURCHILL	GW
28	NV0000052	OK MOBILE HOME PARK	C	CHURCHILL	GW
29	NV0000303	OLD RIVER WATER COMPANY	C	CHURCHILL	GW
30	NV0000054	R AND M MOBILE HOME PARK	C	CHURCHILL	GW
31	NV0002023	SAGE VALLEY PARK LLC	C	CHURCHILL	GW
32	NV0000406	SAND CREEK	C	CHURCHILL	GW
33	NV0000055	TOLAS WATERWORKS CO OP	C	CHURCHILL	GW
34	NV0002594	FALLON LIVESTOCK LLC	NC	CHURCHILL	GW
35	NV0002534	FALLON RV PARK	NC	CHURCHILL	GW
36	NV0002587	GAS STORE WEST	NC	CHURCHILL	GW

	WS#	Water System Name	Type	County	Source
37	NV0002580	HARMON JUNCTION	NC	CHURCHILL	GW
38	NV0002028	LAHONTAN DAM STATE PARK	NC	CHURCHILL	GU
39	NV0000938	LATTIN FARMS	NC	CHURCHILL	GW
40	NV0002014	NEVADA LIVESTOCK MARKETING	NC	CHURCHILL	GW
41	NV0000921	OASIS SPRINGS	NC	CHURCHILL	GW
42	NV0000872	SAGE VALLEY RV PARK LLC	NC	CHURCHILL	GW
43	NV0002581	SKIPS MINI MARKET	NC	CHURCHILL	GW
44	NV0000929	SONIC BURGER	NC	CHURCHILL	GW
45	NV0000306	THE GRID	NC	CHURCHILL	GW
46	NV0002586	TOP GUN SKATE	NC	CHURCHILL	GW
47	NV0002024	KENNAMETAL INC	NTNC	CHURCHILL	GW
48	NV0001185	LOGOS CHRISTIAN ACADEMY	NTNC	CHURCHILL	GW
49	NV0002541	NAS CENTROID EW RANGE	NTNC	CHURCHILL	GW
50	NV0000903	NEW MILLENNIUM BUILDING SYSTEMS, LLC	NTNC	CHURCHILL	GW
51	NV0002216	DOUGLAS COUNTY - EAST VALLEY WATER SYSTEM	C	DOUGLAS	GWP
52	NV0002540	DOUGLAS COUNTY - FAIRGROUNDS/SUNRISE ESTATES	C	DOUGLAS	GW
53	NV0000959	DOUGLAS COUNTY - FOOTHILL WATER SYSTEM	C	DOUGLAS	GW
54	NV0002564	DOUGLAS COUNTY - MONTANA	C	DOUGLAS	GW
55	NV0000931	DOUGLAS COUNTY - SIERRA COUNTRY ESTATES	C	DOUGLAS	GW
56	NV0002054	DOUGLAS COUNTY - WEST VALLEY WATER SYSTEM	C	DOUGLAS	GW
57	NV0000066	GARDNERVILLE RANCHOS GID	C	DOUGLAS	GW
58	NV0000065	GARDNERVILLE WATER COMPANY	C	DOUGLAS	GW
59	NV0000355	INDIAN HILLS GID	C	DOUGLAS	GW
60	NV0000172	PINEVIEW ESTATES	C	DOUGLAS	GW
61	NV0000068	RIVERVIEW MOBILE HOME PARK	C	DOUGLAS	GW
62	NV0000030	SIERRA ESTATES GID	C	DOUGLAS	GW
63	NV0000168	TOWN OF MINDEN	C	DOUGLAS	GW
64	NV0002043	DOUGLAS COUNTY LAMPE PARK	NC	DOUGLAS	GW
65	NV0002218	EAST PEAK LODGE	NC	DOUGLAS	GW
66	NV0000844	SEVEN ELEVEN NO 23074	NC	DOUGLAS	GW
67	NV0005078	DOUGLAS COUNTY - CHINA SPRINGS YOUTH CAMP	NTNC	DOUGLAS	GW
68	NV0000977	DOUGLAS COUNTY - NORTH COUNTY WATER SYSTEM	NTNC	DOUGLAS	GW
69	NV0002227	THE CLUB AT CLEAR CREEK TAHOE	NTNC	DOUGLAS	GW
70	NV0000816	WILLIAMS RIDGE TECH PARK	NTNC	DOUGLAS	GW
71	NV0000032	DAYTON VALLEY WATER SYSTEM	C	LYON	GW
72	NV0000223	SILVER SPRINGS MUTUAL WATER COMPANY	C	LYON	GW
73	NV0000224	STAGECOACH GID	C	LYON	GW
74	NV0005020	CHURCHILL BUTTE COMPLEX	NC	LYON	GW
75	NV0000881	DAYTON TAP HOUSE LLC	NC	LYON	GW

	WS#	Water System Name	Type	County	Source
76	NV0003098	EAST 50 BAR	NC	LYON	GW
77	NV0002132	FORT CHURCHILL HISTORIC STATE PARK	NC	LYON	GW
78	NV0000858	ROGELIO M GARCIA	NC	LYON	GW
79	NV0004100	SILVER SPRINGS MEETINGHOUSE LDS	NC	LYON	GW
80	NV0002608	STAGECOACH COUNTRY MARKET	NC	LYON	GW
81	NV0004040	STAGECOACH MARKET	NC	LYON	GW
82	NV0001195	ACG MATERIALS	NTNC	LYON	GW
83	NV0004053	HODGES TRANSPORTATION CO	NTNC	LYON	GW
84	NV0000240	STOREY COUNTY WATER DISTRICT	C	STOREY	SW